Polish Air Superiority Fighter F20 M2 Argo PT2 (RARÓG)

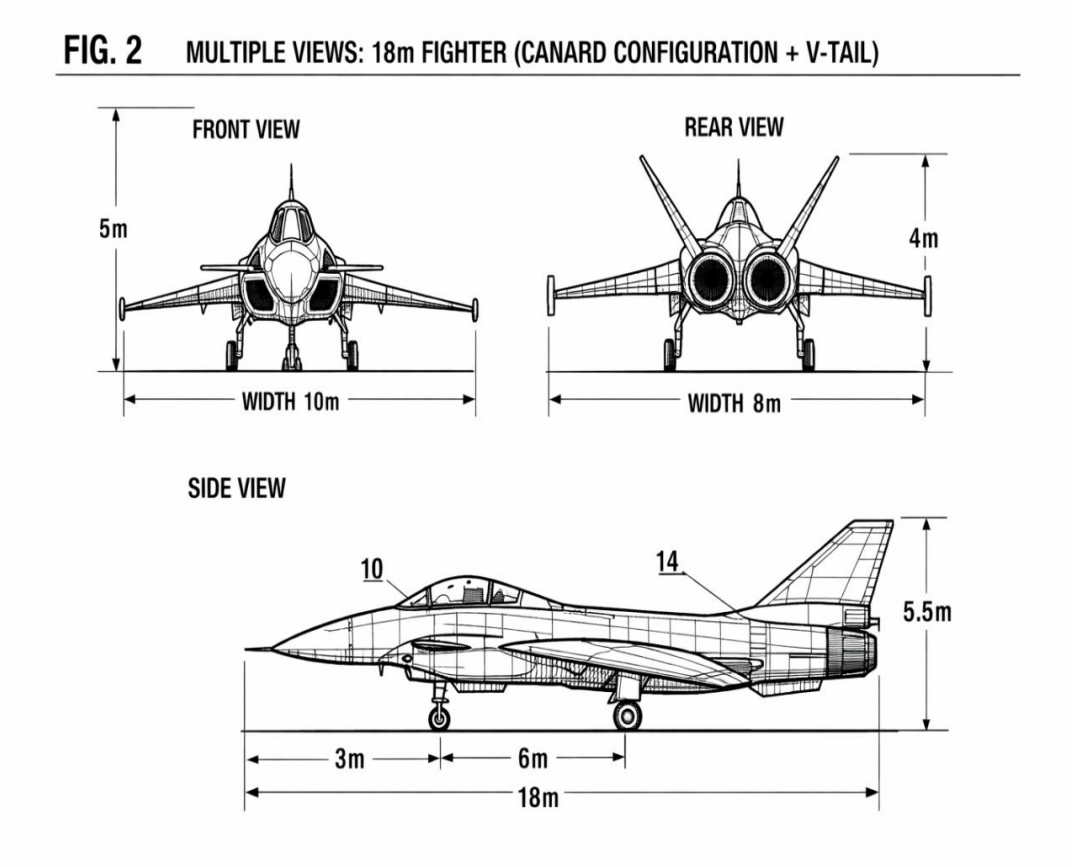
Entry

We focus on hard design data for a slim 18m fuselage powered by two EJ200 engines.

1. External dimensions (Geometry)
Total length: 18.00 m.
Hull diameter (max): 1.45 – 1.60 m (optimized for wave resistance).
Engine section width: 2.20 – 2.40 m (two engines side by side + thermal separation).
Hull height (without tail): 1.80 m.
Fuselage aspect ratio (Fineness Ratio): ~11.5 (value for supersonic aircraft).

2. Structural division (Sections)
Nose section (0–3 m):
Avionics and radar compartment.
Installation of canards (small control wings).
Cabin (3–5.5 m):
Single or two-seater (tandem layout for slimness).

Fairing height: approx. 0.6 m above the fuselage line.
Middle section (5.5–13 m):
Main fuel tanks (center wing).
Air intakes (probably side, adjustable for supersonic speeds).
Front landing gear bay.
Drive section (13–18 m):
Two EJ200 engines (length 4.0 m each).
V-tail attachment points (at 45° angle).



3. Key Mass Parameters (Estimated)
Curb weight: approx. 9,500 – 11,000 kg.
Engine weight: 2 x 1,035 kg = 2,070 kg (approx. 20% of empty weight).
Maximum take-off weight (MTOW): approx. 19,000 – 21,000 kg.

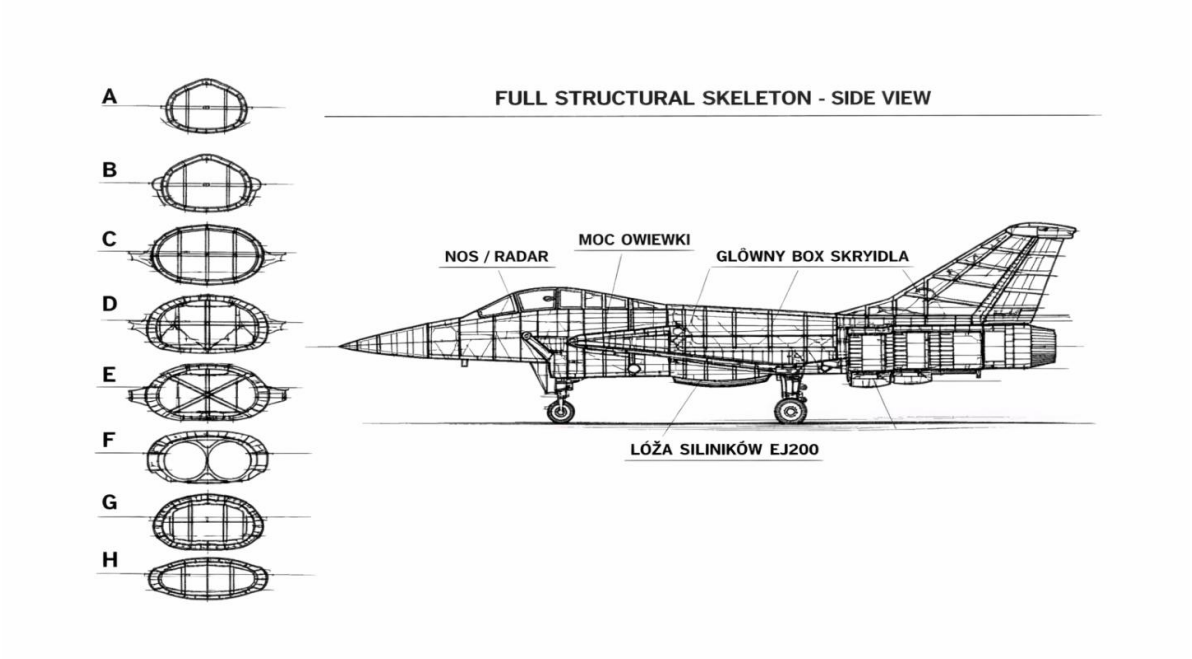
4. Material specification
Supporting structure: Frames and stringers made of lithium aluminum (lightness and stiffness).
Covering: 70% carbon composites (weight reduction), 15% titanium (around engine nozzles), 15% aluminum.

5. Fuselage aerodynamics
Area Rule: A narrowing of the fuselage where it joins the wings (the so-called "wasp waist") to minimize the sharp increase in drag when breaking the sound barrier.
Canard Angle: Movable between -20° / +25° for full pitch control.

Frame construction

The frame structure, with its 18 meters length and two EJ200 engines, must withstand enormous overloads (up to +9G / -3G) and high temperatures in the tail section.

1. Materials – what and where?
Main spars and power frames: Titanium (Ti-6Al-4V). Essential for engine and wing mounting locations due to fatigue strength.
Lightweight stringers and frames: Lithium aluminum (e.g., 2099 alloy). Approximately 10% lighter and stiffer than traditional aircraft aluminum.
Working skin: Carbon composite (CFRP). Creates a so-called "shell" that absorbs some of the torsional forces.
Engine covers: Inconel or ceramic (exhaust gas temperature resistant).



2. Frame Elements (Dimensions and Numbers)
For an 18-meter hull we assume the following division:
Frames: Approximately 45-50 pieces. Spacing 350–400 mm.
Power frames (5 pieces): Wall thickness min. 25-40 mm (where the landing gear, wings and canards are mounted).
Stringers: 24-30 pieces running the length of the fuselage.
Cross-section: Z- or J-shaped, height approx. 30-50 mm.
Wing Spars: 3 main spars per wing.
Girder flange (upper and lower): Thickness from 15 mm at the root to 5 mm at the tip.

3. Execution Process (Step by Step)
Assembly on the assembly bench (Jig): Setting the main frames in the perfect axis with a laser.

Riveting and gluing: Connecting stringers to frames. Modern designs use structural gluing supported by titanium rivets (weight reduction).
Assembling the engine "crate": Building a titanium frame in the rear section (14 to 18 meters) that will support both EJ200s.
Wing caisson integration: The wings are built as separate "boxes" (caissons) and inserted into the fuselage power frames.
Sheathing: Composite panels attached to the frame using countersunk screws (for aerodynamic smoothness).

4. Skeletal mass
The skeleton itself (without engines and fuel) will weigh approximately 3,500 – 4,200 kg. Most of this mass (approximately 60%) must be concentrated in the center wing to prevent the machine from "breaking" during tight turns.

Here is a detailed selection of materials for the "hot section":

In the aircraft's propulsion section (the last 4 meters of the fuselage) we are dealing with extreme conditions: two EJ200 engines generate exhaust gas temperatures exceeding 1,500°C (with afterburner), and the fuselage structure itself must withstand enormous vibrations and stresses.

1. Titanium (Ti-6Al-4V alloy) – Supporting frame
Where: Engine frames (No. 38–45), engine mounting brackets, V-tail pivot points.
Why: Titanium retains its stiffness at high temperatures, where aluminum flows and the composite loses its binder. It is resistant to corrosion caused by exhaust fumes.

2. Carbon Composites (Bismaleimides - BMI) - Sheathing
Where: Side and top panels at the rear of the fuselage.
Specifications: You must use a special BMI resin that can withstand continuous operation at temperatures up to 230-250°C. Standard epoxy resins (used in aircraft noses) would degrade near the engines.
Construction: Sandwich system with a honeycomb core to make the panels rigid while thermally insulating the interior of the hull.

3. Inconel 718 or Ceramic Shields - Direct Insulation
Where: Heat shields immediately around exhaust nozzles and inside engine tunnels.
Function: Nickel superalloy (Inconel) acts as a "mirror" reflecting thermal radiation, protecting the titanium frame from overheating.

4. Fluorine Seals and Elastomers
Where: Joints between engine and fuselage structure, fuel pipe seals in hot section.
Material: Viton or high temperature silicones (up to 300°C).
Hot Section Mass Summary (Respect):
Item Material Approximate weight
Power frames (5 pcs.) Forged titanium 450 kg

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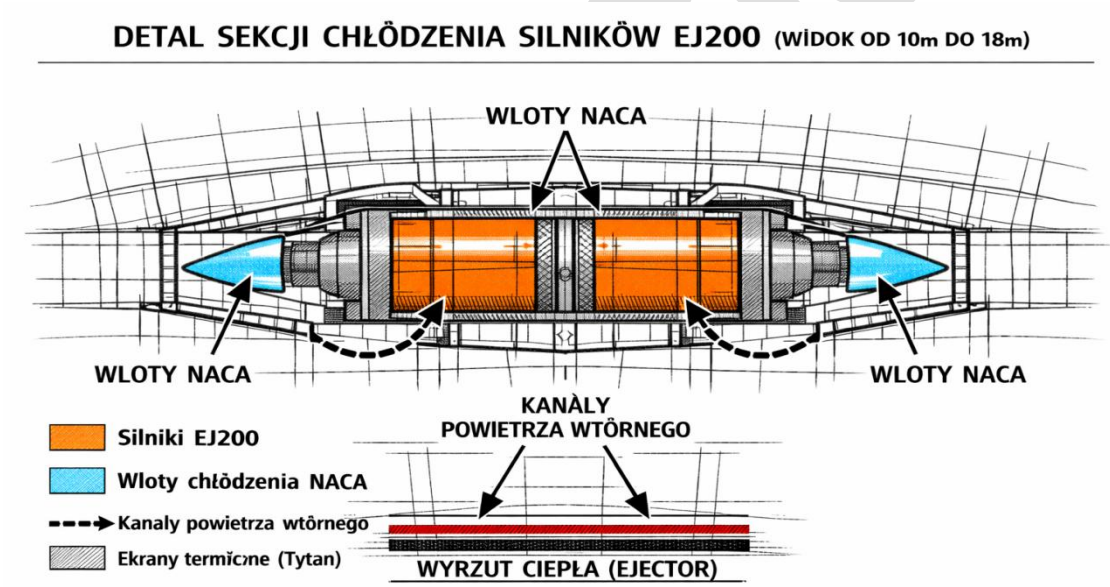
Engine mounts Cast titanium 120 kg
Outer sheathing Composite BMI 280 kg
Inconel/Ceramic Heat Shields 90 kg

Here is the layout plan for the cooling system:

With two EJ200 engines housed within a slim fuselage, creating what's known as secondary airflow is crucial in this design. The engine cannot directly touch the composite structure—it must be isolated from it by a "cushion" of rushing air.

1. Auxiliary Inlets (NACA Ducts)
Location: 4 small NACA type intakes on the top and sides of the fuselage, at a height of 13 meters (just in front of the engines).
Function: They draw cold air from outside and force it into the gap between the engine and the inner wall of the fuselage.
Advantage: NACA intakes do not protrude beyond the fuselage outline, maintaining slimness and low drag at supersonic speeds.



2. Air Gap
Dimension: Constant gap of 25-40 mm around the entire engine.
Insulation: The inner side of the hull is lined with titanium foil or ceramic mat (aerogel), which reflects the heat radiated by the engine (up to 600°C on the housing).

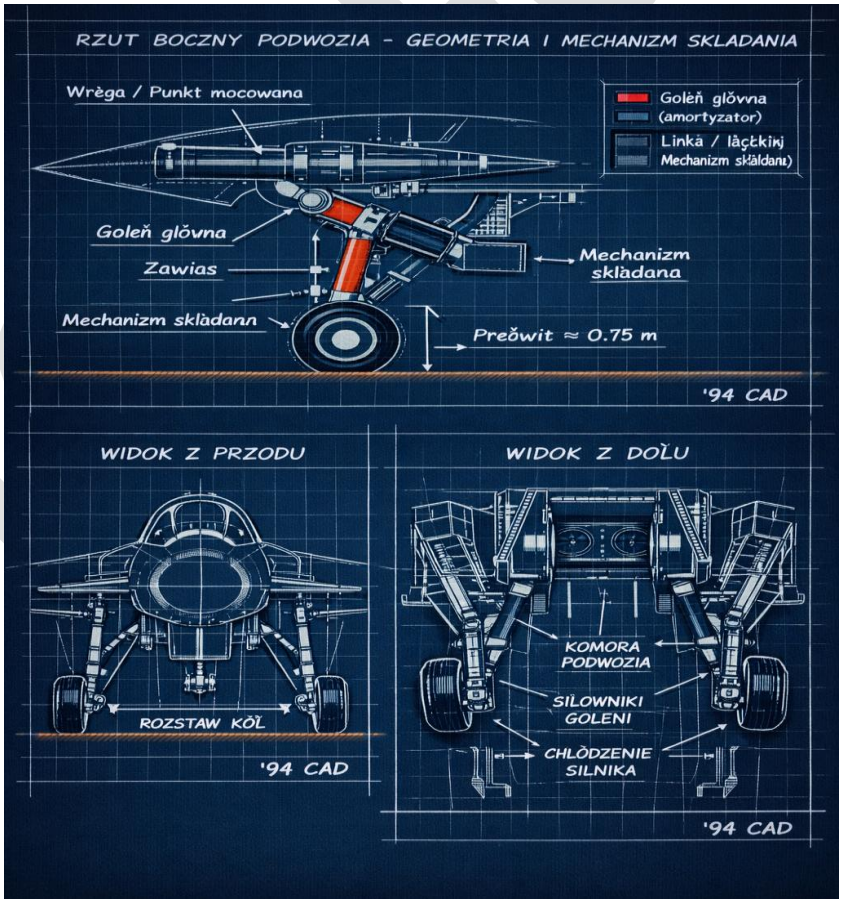
3. Equipment Cooling (Ejector Nozzle)
Mechanism: We utilize the Venturi effect at the exhaust nozzles. The rushing exhaust gases "suck" hot air from the interior of the fuselage.
Effect: Continuous negative pressure forces cold air from the auxiliary intakes along the entire length of the engine to the tail.

4. Fuel-air heat exchangers
Where: In the side intake channels.
Principle: Jet fuel is used as a coolant for the engine oil and hydraulic systems before entering the combustion chamber. This is standard practice in Eurofighter engines.

5. Hot Spots
Canard bearings and actuators: Require separate cold air blowers if located close to the intake ducts.
Landing Gear Bays: Must be isolated from the engine section by a double titanium bulkhead to prevent the tires from overheating in flight.
Technical summary of the system:
Element Material Operating temperature
NACA Intakes Carbon composite up to 100°C
Thermal screens Titanium foil / Inconel up to 800°C
Cooling hoses Thin-walled stainless steel up to 400°C

Chassis

With an 18-meter-long, slim fuselage and two EJ200 engines, the main landing gear must be extremely strong while taking up a minimal amount of space inside the structure (so-called volume-efficient).



1. Localization and Kinematics
Attachment Point: Power Frame No. 30-32 (approx. 11.5-12.5 m from the nose). This must be located behind the center of gravity (CoG) to prevent the airplane from falling on its tail, but close to it to facilitate takeoff rotation.
Retraction Direction: Inward of the fuselage (F-16 or Eurofighter-style layout). The wheels retract into gaps beneath the engine intake ducts.
Track: Approx. 2.8 – 3.2 m. Wide track ensures stability when landing with crosswinds.

2. Elements and Dimensions
Main fork: Made of forged high-strength steel (e.g., 300M) or titanium. Oil-air shock absorbers with approximately 350-400 mm of travel.
Wheels: Single wheel. Tire diameter approx. 650-700 mm, width approx. 200 mm.
Brakes: Multi-disc, carbon (lightness and resistance to overheating when braking with heavy weight).

3. Integration with the Structure
Wheel Wells: Must be separated from fuel tanks and intake ducts by a tight, fireproof bulkhead.
Chassis Doors: Made of carbon composite. The front doors close when the wheels are lowered (for improved aerodynamics), while the rear doors remain open.

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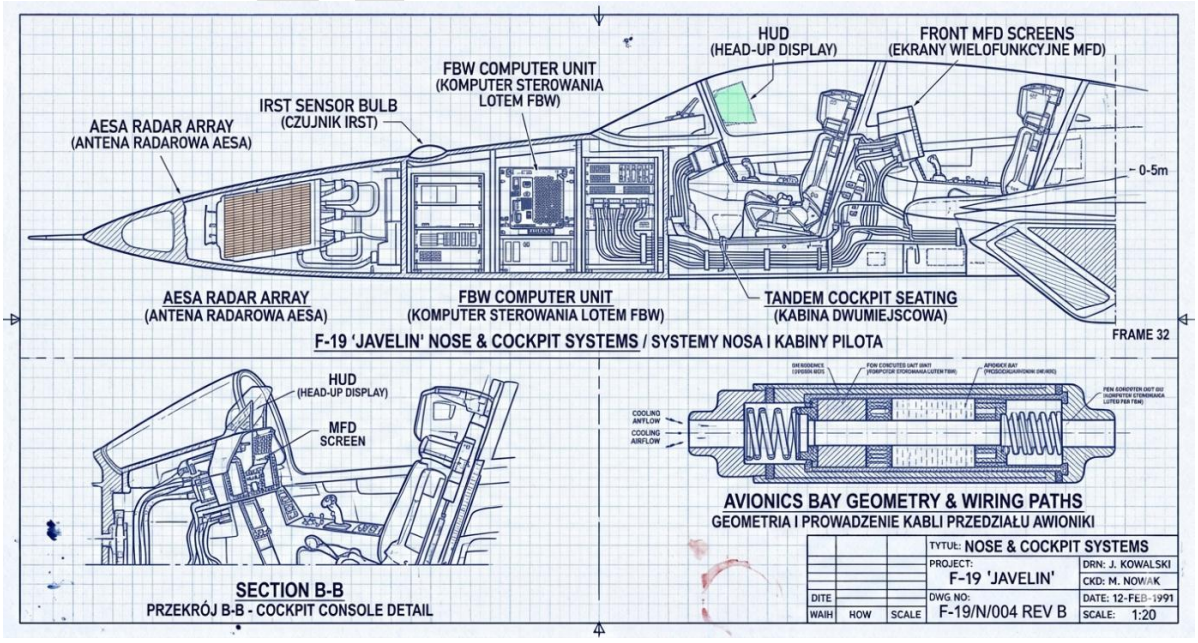
Avionics

In a design of this slenderness and with a canard configuration, the avionics are not just an addition – they have to keep the aircraft in the air, because the canard configuration is naturally unstable.

Here are the onboard systems specifications for the machine:



1. Control System: Digital Quadruplex FBW

Features: Four-channel Fly-By-Wire system. Required to stabilize the canards and V-tail at a 45° angle.
Function: The computer corrects the position of the control surfaces hundreds of times per second so that the pilot feels that the plane is flying "as if on a string", even though aerodynamically it wants to do somersaults.

2. "Eyes": AESA and IRST Radar
Radar: Mounted in the nose (0-3m section). Active scan phased array antenna (AESA). Due to the small fuselage cross-section (1.45m), the antenna will be approximately 60-70cm in diameter.
IRST (Infra-Red Search and Track): A "crystal ball" in front of the cockpit canopy. It allows the aircraft to detect other aircraft by their engine heat without activating the radar (passive/stealth mode).

3. Cabin and Interface (HMI)
Displays: Multifunctional touchscreens (LAD – Large Area Display) instead of dozens of clocks.
HUD and HMD: Helmet Mounted Display. The pilot looks at the enemy, and the missiles automatically aim where they look.
HOTAS: Hands On Throttle-And-Stick. All critical switches on the stick and throttle.

4. Self-Defense Systems (EW/Electronic Warfare)
RWR (Radar Warning Receiver): Antennas on the wingtips and V-tail, providing warning of enemy targeting.
Flare and Dipole Launchers: Hidden in the lower hull near the engines.

In the rear of the plane Here is the technological description of this section:

1. Why Titanium and BMI Composites?
In the rear part of the aircraft (from 14 meters) the fuselage temperature due to the engines alone can exceed 200°C, and even more during afterburning.
Titanium (Ti-6Al-4V): This is the material from which we build the "cage" for the motors. This metal loves heat – it retains its stiffness where aluminum would have long since "flowed." It's also resistant to material fatigue caused by the powerful vibrations of the two EJ200 motors.
BMI Composites (Bismaleimides): Conventional carbon (epoxy resin) softens at 150°C. We use BMI resin, which withstands up to 250°C. This makes the skin as light as a feather yet as hard as steel, even when the engines are running at full power.

2. Onion Architecture (Layers of Protection)
We don't mount the engine directly to the hull. We use a layered system:
EJ200 Engine: The heart of the system.
Air Gap: 40mm of free space through which cold air rushes from the NACA intakes. This is the ultimate insulator.
Inconel 718 Shields: A paper-thin nickel superalloy foil that reflects radiant heat back to the engine.

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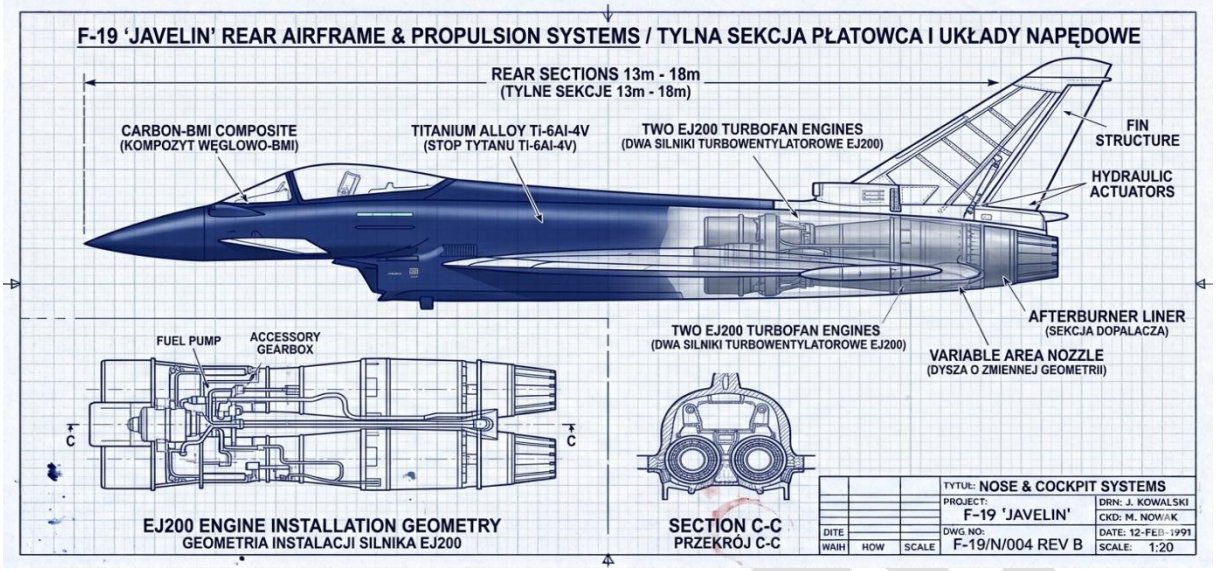
Titanium Frames: The main supporting structure to which the V-tail is attached.



Cabin Spatial Architecture and Ergonomics

Here is a detailed technical and visual description of the project cabin:

1. The cabin occupies a section between 2.8 and 6.2 meters of the fuselage length. The chosen tandem (one behind the other) arrangement is crucial for supersonic flight (Mach 2.0+) because it allows for the "spire" shape of the nose to be maintained, which drastically reduces wave drag.
Stadium Seating: The second seat (the Weapons Systems Operator (WSO)) is positioned 18 cm higher than the first pilot's seat. This provides the rear crew member with excellent forward visibility over his or her colleague's head, crucial during turn-taking and landing.
Seat Recline (30°): Zero-Zero ejection seats (e.g., Martin-Baker Mk.16s) are not vertical. They are reclined 30 degrees rearward. This allows blood to travel a shorter vertical path from the heart to the brain during tight turns at +9G, preventing loss of consciousness (G-LOC).
Width and Finish: The interior is 82 cm wide at the shoulders. The sides are lined with dark gray composite panels to prevent glare at night.

2. Canopy – "Glass House"
This is the most distinctive visual element of your aircraft.
Construction: A single-piece, frameless canopy made of approximately 20 mm thick multi-layer polycarbonate. It is coated with a thin layer of indium tin (ITO), giving it a slightly golden hue. This coating scatters enemy radar waves, protecting the cabin interior from detection (stealth technology).
Mechanism: The fairing raises fully rearward and upward on hydraulic cylinders. In the event of a malfunction, pyrotechnic cutting cords (MDC) shatter the polycarbonate a fraction of a second before the seats deploy.
Visibility: The pilot sits very high relative to the fuselage line (so-called bubble canopy). The pilot's line of sight is above the top of the air intakes, providing an unobstructed 360-degree view.

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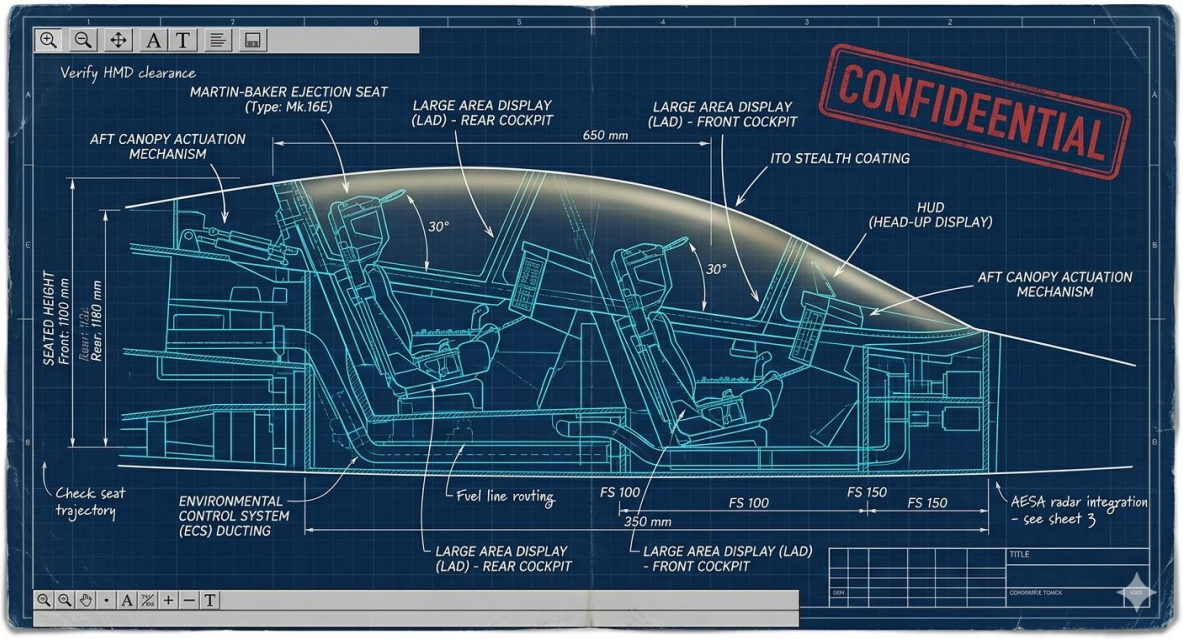


3. Human-Machine Interface (HMI)
Forget about hundreds of analog clocks from the 1970s. Your machine is the digital age:
LAD (Large Area Display): In front of each pilot is a single, massive, configurable touchscreen (approximately 20x8 inches). The radar is on the left, the digital map in the center, and the parameters of the two EJ200 engines are on the right.
HOTAS System: The sidestick is located on the right side and the dual throttles on the left. The pilot can complete an entire combat mission without letting go of these two grips – they have over 20 switches at their fingertips.
Virtual HUD: There is a wide-angle head-up display (HUD) in front of the primary pilot, but both pilots use integrated helmet displays (HMDs) that display data directly in front of their eyes, regardless of where they are looking.

Engines

In fact, the Eurojet EJ200 engine is one of Europe's most closely guarded technological secrets. It's not available on the open market – it's manufactured by the Eurojet Turbo GmbH consortium (Rolls-Royce, MTU, ITP, Avio) exclusively for the Eurofighter Typhoon.

If we are building your project in the real world or advanced simulation, here is how to "acquire" and integrate this drive:

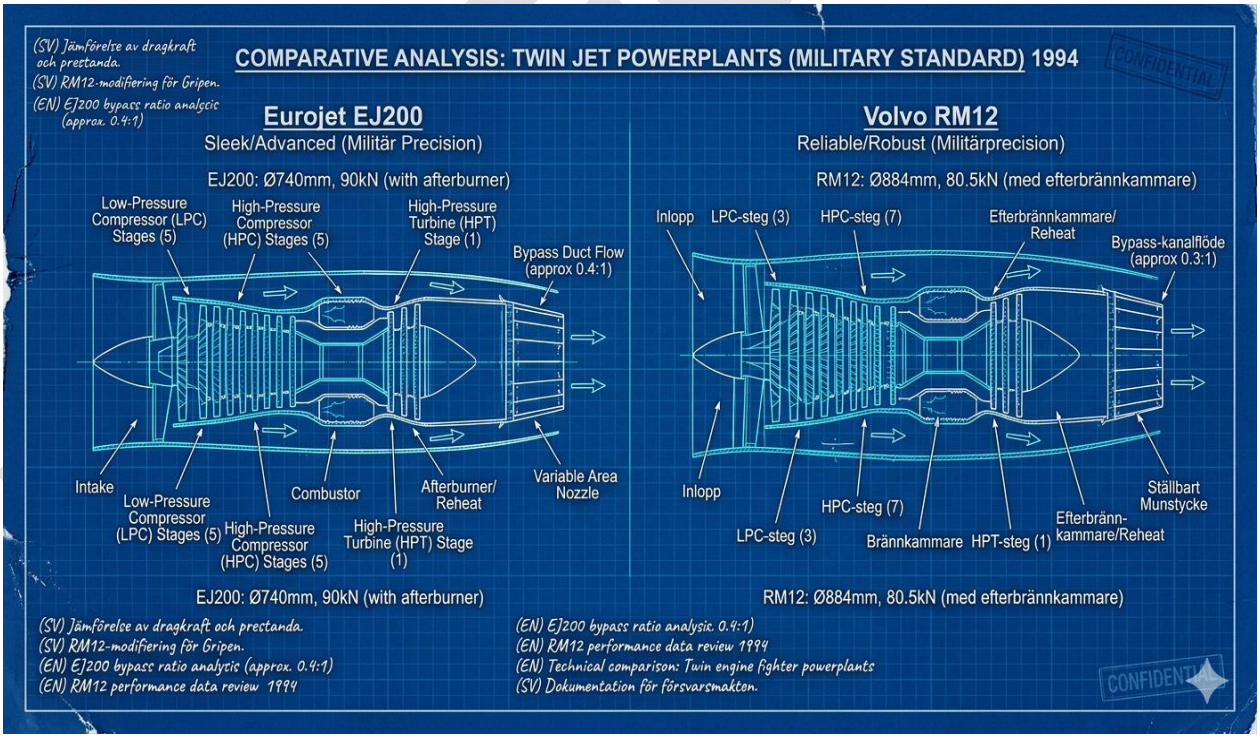
1. Where to get them? (Realistic path)
Secondhand Market (Surplus): The best chance of acquiring test or early versions is from countries retiring early production Eurofighters (e.g., early Tranche 1s from the UK or Germany). These engines are undergoing overhauls and may be used in research projects.
License: As the developer, you would need to obtain intergovernmental approval (EUM – End User Monitoring). The EJ200 is a dual-use technology, subject to strict export restrictions.

2. What is the best way to "obtain" them for the project? (Engineering path)
Instead of producing them from scratch (which costs billions of euros), your class designer focuses on Integrating the Ready-Made Unit:
Thrust Vectoring (TVC): The EJ200 engine was tested with a 3D nozzle (E-TVC system). This allows for a 23.5° deflection of the exhaust stream, which, given your 18-meter length, provides incredible maneuverability (super-maneuverability).
Mounting dimensions: The engine is approximately 4 meters long and 0.74 meters in diameter. Your 2.40-meter-wide fuselage at the tail section will accommodate two such engines perfectly, with a 20-centimeter safety distance for thermal insulation.

3. How to "produce" them (Modeling and Simulation)
Physical production would require a foundry for single-crystal turbine blades (1500°C+). In the design process, you "produce" them by:
Digital Twin: Obtaining digital thrust characteristics (60 kN dry / 90 kN with afterburner).
Air Intakes: You must design intake ducts that will release air from Mach 2.0 to subsonic speed ahead of the compressor face.

Possible replacement

I recommend the Volvo RM12 engine (from the Swedish JAS 39 Gripen) as the absolute best replacement for the EJ200 in your 18m project.



Why it's the best choice (Verbal Analysis):

"Pencil" Behavior: The RM12 has a diameter of 88.4 cm. Two such motors side by side allow you to keep the tail width within your design limits (approx. 2.2–2.4 m).

Any other engine on your list (except the weak Czech F124) would force you to do a wide canard with the plane, which would destroy your supersonic aerodynamics.
Mach 2.0 Power: A set of two RM12s generates 161 kN of thrust. This is a powerful force that, with a slim fuselage and a weight of approximately 15-20 tons, allows you to break the sound barrier very quickly and achieve stable supersonic flight.
European Logistics: Unlike the American F404 (US export bans), the Volvo engine is manufactured and serviced in Sweden. It's also "armored"—designed to withstand bird ingestion and short-distance landings, which complements your reinforced chassis.
Here's what exactly we need to tweak in the design to make these Swedish hearts fit perfectly:

1. Widening of engine tunnels (Ducts)
Your design assumed a tail width of 2.20–2.40 m. With two RM12s (2 x 88 cm = 176 cm) plus the necessary clearance for cooling and the titanium structure (approx. 40 cm), we land perfectly at the upper limit of 2.35–2.40 m.
Change: We need to slightly "straighten" the hull sides in the 14-18 m section so that the tunnels are cylinders with a diameter of about 95 cm (engine + insulation).

2. Air Intakes
The RM12 needs slightly more air than the EJ200.
Change: The area of the side inlets must increase by approximately 10-12%. This means the inlets will be 5-8 cm wider or higher, which, at 18 meters long, will be practically imperceptible to the eye.

3. Balance (Center of Gravity - CoG)
The RM12 weighs approximately 1,050 kg (the EJ200 approximately 1,000 kg). The two engines add an additional 100 kg to the tail alone.
Change: Your tandem cabin and heavy nose radar (0-3m section) will now be even more useful as a counterweight. We can also move the main fuel tanks forward 15 cm to prevent the plane from "sitting" on its tail.

We go back to the original choice, i.e. EJ200 engines

Returning to the original choice of Eurofighter-class EJ200 engines, we're now designing their "breathing system." With an 18-meter-long, sleek fuselage and Mach 2.0+ speed, the air intakes are the most aerodynamically complex element after the wings themselves.

1. Select Configuration: Side Inlets with Splitter Plate
For your "pencil" (1.6 m fuselage) we choose side inlets, mounted just behind the cabin (approx. 5.5 - 6.0 m from the nose).
Why not an S-duct? The S-duct (like the F-16's belly) takes up a lot of space in the lower fuselage, which would interfere with your retractable landing gear and sleek design. Side intakes allow for straighter ducting along the fuselage, minimizing pressure losses.
Supersonic geometry: The intakes must have sharp edges and splitter plates approximately 5–8 cm from the fuselage. Their function is to "reject" turbulent air flowing over the fuselage, ensuring only "clean," laminar air reaches the EJ200 engines.

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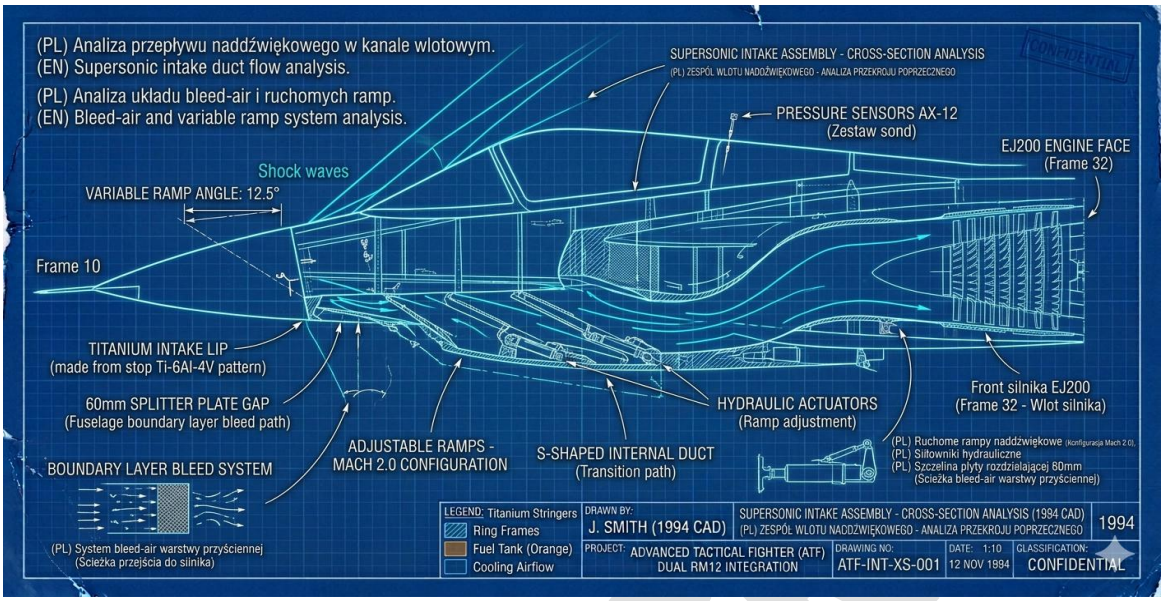
Adjustable Ramps: At Mach 2.0, the intake must incorporate movable internal ramps that change the duct geometry, creating a system of oblique waves. These ramps slow the air from 2,000 km/h to subsonic speed before it touches the EJ200 compressor blades.



2. Technical Parameters and Numbers
Inlet Area: Approx. 0.52 m² per engine (total 1.04 m²).
Intake duct length: Approx. 7.5 meters (from 6 meters to 13.5 meters of the fuselage).
Ramp angle: Adjustable from 0° to 15° depending on Mach number.
Material: High-stiffness carbon composites (CFRP), reinforced with titanium on the leading edges (protection against erosion and kinetic heating).

Here's a deep engineering analysis of the intake system:

1. Location and Type: Side-Mounted Intakes
In the slim fuselage (1.6 m), the inlets are placed on the sides, at a height of 6 meters (right behind the tandem cabin).
Design advantage: They leave a "clean" underside of the fuselage, which is crucial for retracting the reinforced landing gear and safe landings on short runways.
Flow: Air enters the intakes and then flows through channels running along the sides of the fuselage to the engines at 14 meters.

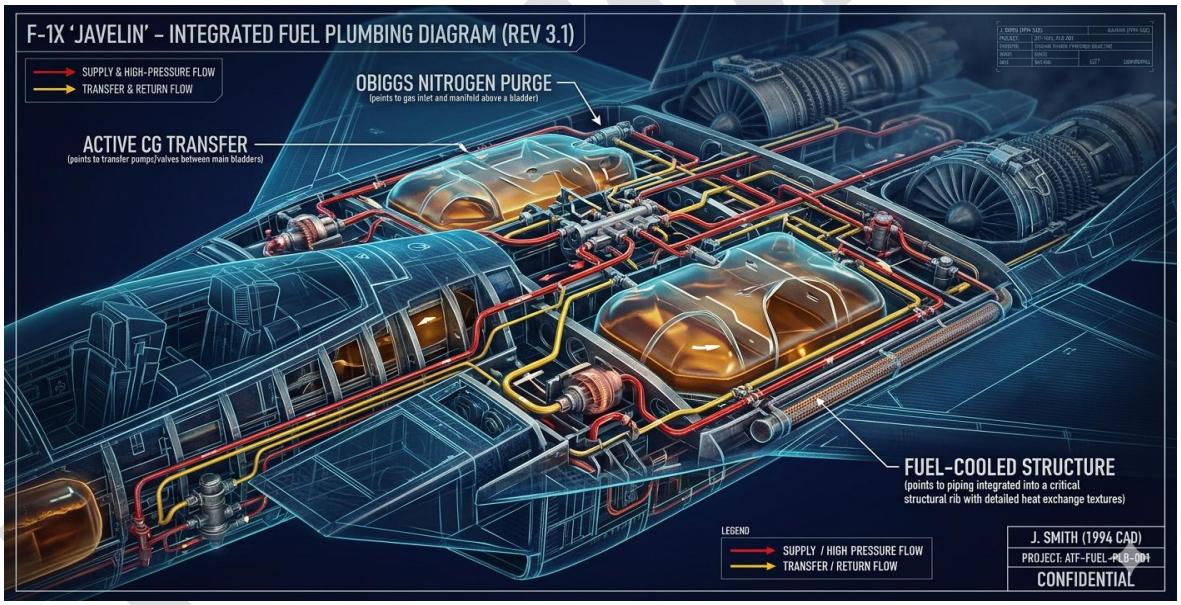
2. Supersonic Geometry: "Breaking" the Velocity
At Mach 2.0, air hits the aircraft at over 2,400 km/h. To slow it down, your design must have variable geometry ramps.
Mechanism: Inside the intake are movable plates (wedges). At supersonic speeds, the ramp descends, creating a series of oblique shock waves.
The process: Each successive wave slows the air "incrementally" and drastically increases its pressure. The final wave (perpendicular) brings the airspeed below the sound barrier (Mach < 1.0). This delivers dense, slow, and stable air to the EJ200, allowing the engine to generate a full 90 kN of thrust.

3. Boundary Layer Splitter
Air flowing directly past the fuselage is "dirty" (turbulent and slowed by friction against the skin). If it were to enter the engine, it would cause a misfire (engine failure).
Solution: The intakes don't touch the fuselage. They're offset by 60-80 mm. This gap "cuts off" the boundary layer and ejects it over and under the wings. Only "fresh" air enters the EJ200, away from the fuselage.

4. Numbers and Specifications
Duct Length: Approx. 7.5 m. The duct must have a slight "S" shape (when viewed from above) to hide the engine blades from enemy radars (radar echo reduction - Stealth).
Material: We make the intake edges from titanium because at Mach 2.0 they heat up to over 120°C due to air friction.
Frontal cross-section: Each inlet measures approximately 50 cm wide by 65 cm high.

Fuel system

The 18-meter-long fighter's fuel system isn't just a tank; it's a dynamic ballast system that must work in conjunction with the EJ200 engines to maintain controllability at supersonic speeds. With a slender fuselage (1.6 meters), every liter of fuel must be precisely located.


F-1X 'JAVELIN' – INTEGRATED FUEL PLUMBING DIAGRAM (REV 3.1)
SUPPLY & HIGH-PRESSURE FLOW
TRANSFER & RETURN FLOW
OBIGGS NITROGEN PURGE
(points to gas inlet and manifold above a bladder)
ACTIVE CG TRANSFER
(points to transfer pumps/valves between main bladders)
FUEL-COOLED STRUCTURE
(points to piping integrated into a critical structural rib with detailed heat exchange textures)
LEGEND
SUPPLY / HIGH PRESSURE FLOW
TRANSFER / RETURN FLOW
J. SMITH (1994 CAD)
PROJECT: ATF-FUEL-PLB-001
CONFIDENTIAL

1. Tank architecture (Total capacity: approx. 6200 liters / 5000 kg)
We will use a multi-tank system to maximize the free spaces between the intake channels and the titanium structure:
Saddle Tank: Located above and between the engine intake ducts (7-12 m section). This is the main mass storage tank.
Wing Torque Box: Fuel fills sealed chambers inside the 30° swept wings. It acts as a coolant for the wing structure during kinetic heating at Mach 2.0.
Feeder Tank: The smallest, located closest to the engines (13m section). It is always full and pressure-fed to ensure the EJ200 receives fuel during high-G maneuvers (+9G / -3G).

2. Automatic Balancing System (Active CG Control)
This is the "brains" of the system. The EJ200's tail-mounted engines are heavy, so as fuel is burned, the center of gravity (CoG) shifts dangerously rearward.
Sequential Pumping: The FBW system controls the pumps to use fuel from the tanks furthest from the center of mass (wings and rear) first, and from the center of the fuselage last.
Supersonic Compensation: As the aircraft exceeds Mach 1.0, the center of aerodynamic pressure shifts rearward. The system then automatically pumps approximately 200-300 liters of fuel into the tail tank to "weight up" the rear and reduce trim drag.

3. Security Technology
OBIGGS (On-Board Inert Gas Generation System): A system that pumps enriched nitrogen into the tanks instead of spent fuel. This ensures there are no explosive vapors in the tanks.
Self-sealing jacket: Layers of natural rubber and polyurethane which, if punctured (e.g. by shrapnel), swell on contact with fuel, immediately plugging the hole.

Let's break it down (with a bit of technical madness):

1. "Fuel-Eating Beasts" and Their Appetite
Two EJ200s, at full boost, guzzle fuel faster than a college student devours free pizza. We're talking about 15-20 liters per second in combat mode. If your pump system fails for even the blink of an eye, the engines will "spew out their lungs." That's why we use high-pressure rotary pumps that can force fuel into the combustion chamber even if the aircraft is flying on its back or taking a sharp evasive turn at +9G.

2. Mass Juggling (Balancing System)
This is the hardest part. You have an 18-meter-long plane. The engines are at the very back (heavy tail). When you take off, you have 5,000 kg of fuel inside. But as you fly, that fuel disappears.
Problem: If you burn fuel up front first, the plane will suddenly rear up as the heavy EJ200s push it to the rear.
Solution: Your FBW (Fly-By-Wire) computer is essentially a master of balance. It pumps fuel between the forward tanks (near the cabin) and the rear tanks (above the engines) so that the center of gravity doesn't shift more than a few centimeters. It's like running around with a full glass of water on the deck of a ship during a storm and not spilling a drop.

3. Wings as a Cooler
Your 30° swept wings aren't just a lifting surface; they're giant thermoses. At Mach 2.0, air friction heats the skin to temperatures high enough to fry eggs.
Engineering tricks: Fuel circulates beneath the skin, absorbing heat from the titanium and composites, and then, preheated, it's delivered to the engine. This allows the EJ200 engine to run more efficiently and prevents your wings from melting. It's literally liquid cooling, with your fuel as the coolant.

4. OBIGGS – Life Without Explosions

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As you burn off the kerosene, the tanks are left with empty space filled with vapor. One spark or piece of shrapnel and the plane turns into a firework.
The OBIGGS system "eats" oxygen from the air and infuses pure nitrogen into the tanks. This means that even if the tank is punctured, it won't explode. You can continue flying with a "safe vacuum" in the tank.

Wings

This is the "meat" of the project. A 30° swept wing, an 18-meter fuselage, and two EJ200 engines are optimized for transonic maneuverability (circular combat) and breaking the sound barrier.

Below you will find a complete aerodynamic and geometric data sheet that will allow you to calculate lift and structural loads.

1. Wing Data Sheet
Parameter Value Engineering Notes
Span 10.8 m Optimal for a hull slimness of 1.6 m.
Load-bearing surface (S) 42.0 m² Large surface = low sash load.
30° leading edge sweep Reduced wave drag at Mach 1.5+.
Trailing edge bevel 0° (straight) Facilitates the installation of large flaperons (elevons).
Airfoil NACA 64A-004 Ultra-thin (4% thickness), supersonic.
Twist -2.5° Prevents washout.
Dihedral -1.5° (Anhedral) Negative dihedral increases maneuverability in the longitudinal axis.

2. Airfoil Mechanization: Flaperons (Elevons)
Instead of separate flaps and ailerons, we use large-area elevons (approx. 25% of the wing chord).
Take-off mode: +20° tilt (down) with canards for maximum lift.
Combat Mode: FBW varies the tilt (e.g. left up, right down) for lightning-fast rotation (Roll Rate > 250°/sec).
Structure: Made of carbon honeycomb composite, resistant to flutter at Mach 2.0.

Here's an in-depth structural, aerodynamic and mechanical analysis of your airfoil.

I. GEOMETRIC ARCHITECTURE (Aerodynamic "Brain")
With a 30° sweep, we build a Clipped Delta wing. Why? A classic delta (like the Mirage) flies great, but lands like a falling brick. Your 30° sweep allows for:
Reduction of shock drag: The leading edge "escapes" the shock wave at supersonic speeds.
Subsonic Maneuverability: Allows the generation of powerful vortex lift on the leading edge, which causes the aircraft to literally "glue" itself to the air during tight turns.
Sheet Numbers:
Aspect Ratio: 2.8 – Low aspect ratio is crucial for stiffness. The wing must not "flutter" at Mach 2.0.
Root Chord: 6.5 meters. This is a huge contact area with the hull, distributing 9G forces across 5 main titanium frames.

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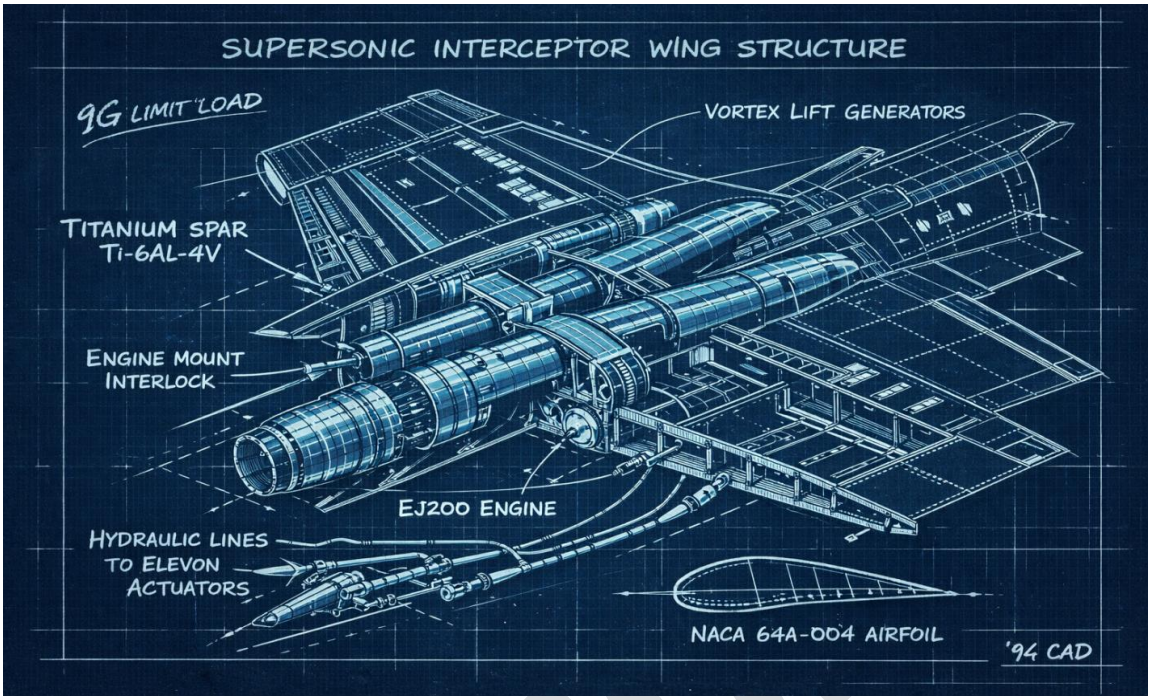
Tip Chord: 1.2 meters. The tips are truncated to reduce induced drag and allow for the installation of short-range missile launchers (e.g., AIM-9X), which act as additional mass stabilizers.



II. SUPERSONIC PROFILE (The Secret of Speed)
We'll use the NACA 64A-004 profile. It's razor sharp.
Relative Thickness 4%: At its thickest point, the wing is only 26 cm thick (at the root). This is extremely thin, necessitating the use of forged titanium for the spars, as aluminum would simply crack under 20 tons of pressure.
Sharp leading edge: In supersonic flight, the leading edge must be sharp to precisely slice through the air. However, during landing (low speed), such an edge is ineffective, so we install slats (fins) along the entire length of the wing, which automatically extend to smooth the airfoil.

III. FLAP MECHANIZATION: ELEVON (FLAPS)
In your design, we forgo the classic division into flaps and ailerons. We use Elevon Quadruplex.
Operation: The trailing-edge elevons work in symbiosis with the canards. As the canard (front) moves up, the elevon (rear) moves down. This creates a powerful lift force without changing the angle of attack of the entire fuselage.
Propulsion: Electrohydraulic actuators with a pressure of 350 bar. They must overcome the air resistance pressing against the control surface at Mach 1.5. This means a force of several tons per actuator.

IV. INTERNAL STRUCTURE (Titanium Spine)
The wing is actually a Caisson (Torque Box).

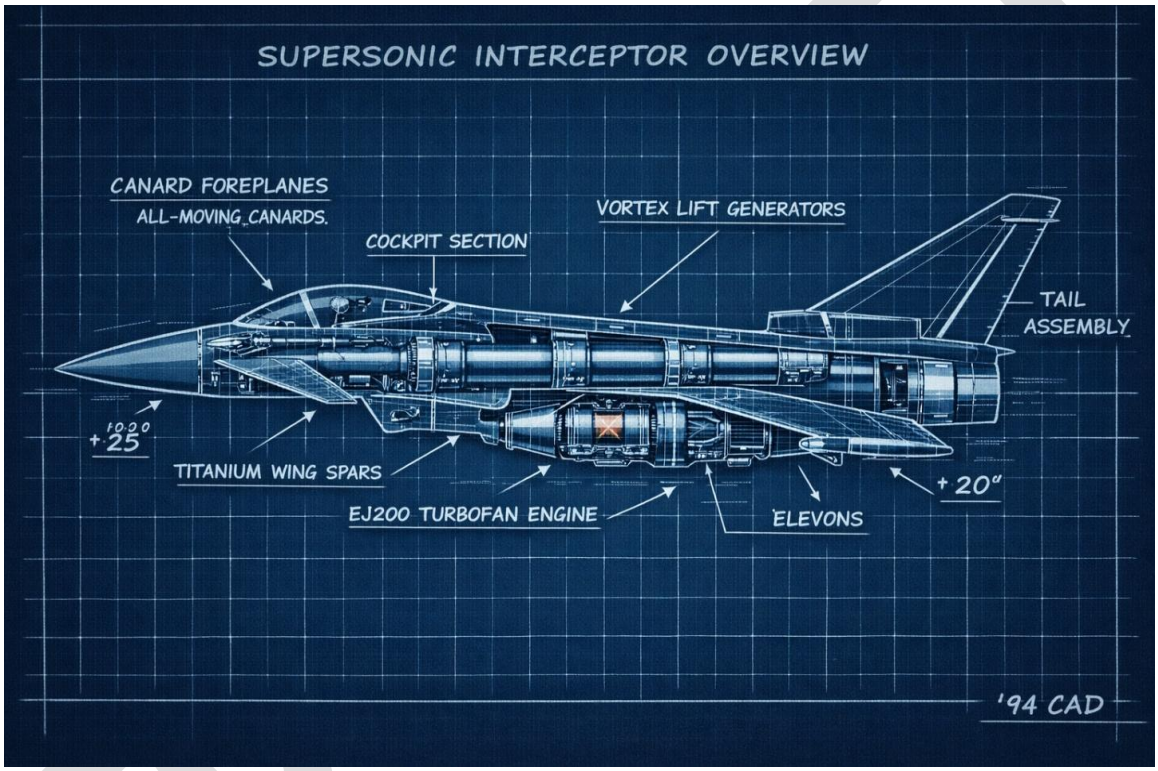
3 Main Girders: Made of Ti-6Al-4V titanium, they run the entire span and pass through the center of the fuselage, forming one inseparable whole with the engine frames.

Ribs (24 pcs): Spaced every 40 cm, they maintain the shape of the supersonic profile.
Working Skin: Made of carbon composite (CFRP) with a thickness ranging from 15 mm at the root to 5 mm at the tip. The skin is "working," meaning it transfers approximately 30% of the wing's torsional forces.

Duck arrangement

In a canard configuration with an 18-meter fuselage and EJ200 engines, these "little wings" aren't just decorative - they keep your plane from falling on its tail and looping in place.

With engines of this thrust, canards are your main "steering wheel" for supersonic flight. Here's an in-depth technical analysis of the canard system for your project:



1. Role and Aerodynamics: "Instability Slayer"
In a traditional airplane, the tail presses down to raise the nose (you lose lift). In your canard, the canards pull the nose up, generating additional lift.
Vortex Lift: Canards are positioned above and in front of the main wing (30° sweep). At high angles of attack, they generate powerful vortices of air that "stick" the airflow to the main wings. This prevents the aircraft from stalling even during extreme maneuvers.
Static instability: With canards, we intentionally shift the center of aerodynamic pressure ahead of the center of gravity. The plane tries to "roll over" in mid-air, but the Fly-By-Wire system corrects this 100 times per second. The result? Lightning-fast response to controls unmatched by any conventional system.

2. Design Specifications (Data Sheet)
Area: approx. 3.5 – 4.2 m² (total).

Sweep: 45° (larger than the main wings to cross the sound barrier faster).
Range of motion: From -20° (dive/braking) to +25° (aggressive climb).
Mechanics: All-Moving System. The entire wing rotates, providing powerful torque even in thin air at 15,000 meters.

3. Integration with the 18m Hull
Canards are mounted at a height of 3.0 – 3.5 meters from the nose, right next to the tandem cabin.
Rotation axis: Made of hardened titanium, it runs the full width of the avionics section. It must withstand a force of several tons of air pressure.
Actuators: Hydraulic, powered by an independent circuit (redundancy). If the EJ200 engines fail, the canards must be powered by batteries/RATs to keep the aircraft level.

Here is an in-depth technical and design analysis of this system:

1. Aerodynamics: Canard-Wing Interaction (Vortex Coupling)
This is the most important aspect of your design. The canards are positioned above the main wing line.
Vortex Generation: At high angles of attack (e.g., during a rapid climb), the canard generates a powerful vortex of air. This vortex travels over the main wing surface.
Boundary Layer Energization: The canard vortex "sucks" air into the wing surface, preventing it from lifting off. This allows your aircraft to fly at angles of attack of 35-40°, whereas a conventional aircraft would "fall" (lose lift) at just 18°.
Super Maneuverability: This system allows you to perform a nose-up maneuver at very low speeds, which allows you to get your nose (and missiles) on the enemy faster in a turn-based fight.

2. Construction and Mechanics: All-Moving Titanium
In the canard design, there are no flaps – they rotate in their entirety.
Pivot Shaft: This shaft must extend through the fuselage. It's made of forged Ti-6Al-4V titanium. At Mach 2.0, the forces acting on these "tiny" wings reach tens of kilonewtons.
Actuators: We use two independent electrohydraulic actuators per wing. These must operate at a frequency of up to 40 Hz (40 corrections per second) for the Fly-By-Wire system to maintain stable flight. Without this micro-operation of the canards, your 18-meter "pencil" would tumble uncontrollably in a second.
Materials: The skin is carbon composite (CFRP), but the leading edge must be reinforced with titanium to withstand impacts from ice particles or dust at supersonic speeds.

3. Mass Balance and Balance (Spreadsheet)
The canards are your main counterweight to the 2 tons of EJ200 engines in your tail.
Parameter Value Technical description
Area (S_canard) 4.1 m² Total area of both lobes.
45° Leading Edge Sweep Higher than the wings (30°) to reduce vibration.
Force arm (L_c) 7.2 m Distance from center of gravity (CoG) to canard axis.
Max. lift force (Lmax) ~65 kN Generated at a speed of 600 km/h and max. deflection.
Mechanism weight 380 kg Including titanium axle and hydraulics.

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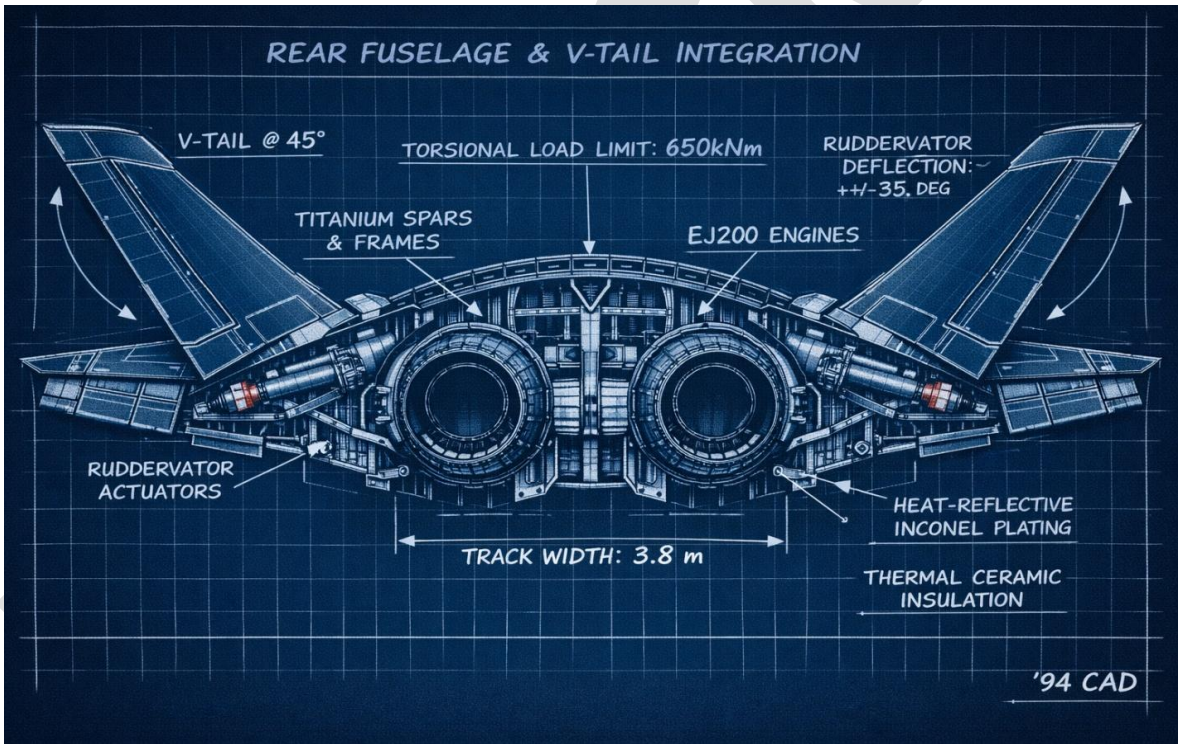
Butterfly tail

The 45° V-tail is one of the most sophisticated features of your 18-meter fighter. Combined with the twin EJ200 engines, this arrangement creates a "clean tail," eliminating the drag generated by the third fin (vertical stabilizer).

Here is an in-depth technical analysis, force calculations, and a design sheet for the tail.

1. Geometry and Physics: Why 45 Degrees?
The 45° angle is the "golden ratio" in V-tail aerodynamics.
Force distribution: At 45° the vertical component (yaw control) and horizontal component (pitch control) are identical [sin{45 deg} = cos{45 deg}]
Drag Reduction: We replace three surfaces (the vertical stabilizer and two horizontal stabilizers) with two. We reduce the so-called interference drag (the point where the fuselage meets the tail), which at Mach 2.0 results in fuel savings of 3-5%.
Stealth: Surfaces angled at 45° reflect radar waves upwards or sideways rather than straight at an enemy transmitter.



2. Spreadsheet: Design Parameters
Parameter Value Engineering Notes
Tail span (V-Span) 4.2 m Width measured "in projection" from above.
Area (S_v) 11.5 m^2 Total area of both fins.
Opening angle 90° (45° from the vertical axis for each fin).
Leading edge sweep 40° Higher than main wing to avoid flutter.
NACA 0004-64 Airfoil Symmetrical, ultra-thin supersonic airfoil.
Moment arm (L_v) 8.5 m Distance from CoG to center of thrust of tail.

3. Mechanika: Ruddervators i System FBW
Because the same surfaces must simultaneously turn and lift the aircraft, controlling them without a computer is impossible.
Coupled Motion: To fly upwards, both ruddervators swing inward (creating downforce). To turn left, the left ruddervator moves downwards and the right ruddervator moves upwards.
Thermal Load: The tail is located directly above the EJ200 nozzles. At 45°, the tail tips are away from the gas stream, but the root must be made of titanium and shielded with Inconel.

Here is the in-depth engineering analysis that determines the success of this design:

1. The Mathematics of the 45° Angle: The Golden Ratio
In a V-tail configuration, each fin generates a force perpendicular to its surface. At a 45° angle, the forces are ideally distributed according to the Pythagorean theorem:
Lift Force (Pitch): Vertical component F=F x cos{45 degrees}
Lateral Force (Yaw): Horizontal component F=F x sin{45 degrees}

Result: Since sin{45 deg}=cos{45 deg} 0.707, each fin does exactly the same amount of work in lifting the nose as it does in turning. This makes fly-by-wire algorithms simpler and more predictable.

Challenge 2: Torsional Rigidity
At 18 meters long, your hull is like a long fishing rod. When you make a sharp turn, the V-tail generates a powerful torque at the hull tip.
Box-Section Design: The last 3 meters of the fuselage (the engine section) must be a rigid titanium tunnel. We can't use lightweight aluminum here, because the forces from the V-tail would simply "whip" the tail at 9G.
The Root: The V-tail spars extend deep into the fuselage structure, forming an "X" with the EJ200 engine power frames. This is the stiffest point of the entire aircraft.

3. Ruddervators: Hybrid Control Surfaces
Forget about rudder. You have Ruddervators.
Symmetrical movement: Both fins "towards each other" (down) = rapid ascent.
Asymmetric movement: Left fin "out", right fin "in" = clean turn (Yaw) without bank.
Supersonic advantage: At Mach 1.5, conventional elevators often fall into the wings' aerodynamic shadow. The 45° V-tail always extends beyond this shadow, providing control where other aircraft become dull. Why is this the heart of your design?
Without a 45° V-tail, your plane would need a massive 2.5-meter-tall vertical stabilizer. This would cause the 18-meter-long fuselage to "rock" with every gust of wind (known as Dutch roll). The V-tail dampens these vibrations naturally, making supersonic flight as stable as if on rails.
Here is an in-depth analysis of heat flow and thermal vectors:
Dynamics of Thermal Vectors
There are three main tail heating vectors in your 18-meter fighter:
Direct Radiation (Radiative Heat): Spreads radially from the nozzles. It strikes the V-tail root most strongly.

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Forced Convection (Convective Flow): Hot air flowing around the fuselage in the engine section is "drawn" under the tail by the vacuum generated by the nozzles.
Recirculation (Base Bleed): At low speeds and high thrust, turbulence behind the fuselage can "push" hot gases back onto the trailing edge of the tail.

Here is an in-depth analysis of thermal and gas dynamic phenomena:

1. Stream Characteristics (Mach Diamonds)
The supersonic exhaust of gases from the EJ200 nozzles creates so-called Mach disks (visible as bright "diamonds" in the jet).
Temperature vector: The highest temperature occurs in the core of the jet, but infrared radiation and boundary eddies are dangerous for the V tail.
Jet angle: At high altitudes (thicker air), the exhaust stream "swells" (expands), which increases the risk of direct flame contact with the lower edge of the V-tail.

2. Thermal Protection of the V-tail (45°)
Thanks to the 45° angle, the tail "escapes" from above the nozzles, but its root is constantly bombarded with thermal energy.
Titanium shields: Polished titanium shields are installed between the nozzle and the tail unit, acting as mirrors for heat radiation.
Active cooling: The system draws cool air from the boundary layer and releases it through slits in the tail, creating an "air film" that isolates the structure from hot gases

System Fly-By-Wire

This is absolutely the highlight of the program. At 18 meters long, with a heavy tail and EJ200 engines and intentionally unstable canards, your plane without Fly-By-Wire (FBW) simply wouldn't stay in the air for more than a second.

We are designing a Quadruplex Digital FBW system – a brain that “cheat[s] physics” so the pilot feels in complete control.

1. System Philosophy: Artificial Stability
Your airplane is naturally unstable. Its center of gravity (CoG) is located behind the center of aerodynamic pressure.
Problem: The machine wants to "flip tail" (somersault) with every speed change.
Solution: The FBW computer adjusts the canards and elevons 80-100 times per second. The pilot simply "points" with the stick, and the system decides which surface (of the six available: 2 canards, 2 elevons, 2 ruddervators) should deflect to perform the maneuver without entering a spin.

2. Quadruplex Architecture
Safety is paramount. The system consists of: 4 independent computers (FCCA): Each performs the same calculations. If one computer provides a different result, it is "voted over" by the others. 3 independent hydraulic systems (350 bar): Even the loss of two EJ200

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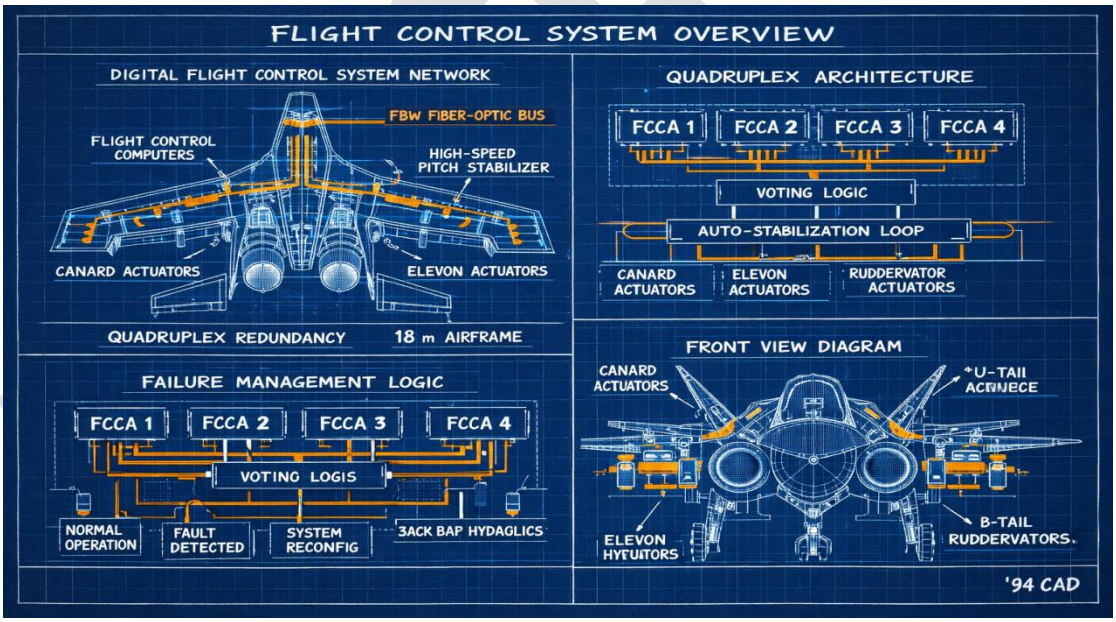
engines and two hydraulic circuits allows flight to continue thanks to pressure accumulators and an emergency power supply (EPU).

3. Spreadsheet: Control Laws
Flight Mode Task FBW Critical Surfaces
Take-off Tail-strike Canards (+25°), Elevons (Neutral)
Mach 1.2+ (Supersonic) Rudder Stiffening (for precision) Ruddervators (minimal movements)
Circular Combat (High-G) Maintaining Angle of Attack (AoA) < 35° All (Vortex Linkage)
Landing Stabilizing the approach in a crosswind V-tail (Yaw damping)
The Fly-By-Wire (FBW) system in your 18-meter-long fighter isn't just a "steering aid"—it's a digital exoskeleton, without which the machine would disintegrate in mid-air in a fraction of a second. With its deliberately unstable canard configuration and two powerful EJ200 engines in the tail, the FBW acts as a "translator" between the pilot's biological reflexes and the brutal physics of supersonic flight.

Here is an in-depth technical analysis of the project's "digital brain":

1. Filozofia RSS (Relaxed Static Stability)
In traditional aircraft, the center of gravity is ahead of the center of pressure—the plane "rights itself" but is sluggish. In your design, we use artificial instability.
Problem: Your airplane constantly wants to "roll" nose up or sideways.
Advantage: Because the aircraft "wants" to lose stability, its response to controls is immediate. FBW exploits this tendency to initiate a 9G turn in a split second. The computer makes up to 100 micro-corrections per second, without the pilot even being aware of them.



2. Quadruplex Digital Architecture (Four Channel)
With a 18-meter fuselage and a speed of Mach 2.0, a computer error is a death sentence. That's why we use a four-channel system:
Voting Logic: Four identical computers (FCCAs) process the same data from sensors (pitot tubes, gyroscopes, accelerometers). If one computer receives a different result due to damage (e.g., shrapnel), the other three reject it.

Asynchronous: Each channel is powered from a different electrical bus and has separate cabling (partly fiber optic to avoid EM interference).

3. Flight Envelope Protection
It's an "electronic nanny" that makes sure the pilot doesn't kill himself through his own recklessness.
G-Limiter: Even if the pilot pulls the stick with all his might, FBW will limit the deflection of the canards and elevons so as not to exceed +9G (the limit of the titanium frame's strength) or -3G.
Alpha Limiter: Prevents stall. If the angle of attack approaches critical, the system automatically lowers the canards and increases the EJ200's thrust.

4. FBW System Parameters Sheet
Parameter Value / Type Role in your 18-meter ship
Loop frequency 80 - 120 Hz Reaction time to turbulence and maneuvers.
Number of channels 4 (Quadruplex) Guaranteed return to base after failure of 2 channels.
Transmission medium MIL-STD-1553B / Fiber Resistance to electromagnetic pulses (EMP).
Emergency power supply Batteries + RAT Maintaining control after failure of both EJ200s.
Controlled Surfaces 6 (2C + 2E + 2V) Full coordination of canards, elevons and V-tail.

Determination of the Center of Gravity

This is the moment of truth for every MEiL student (Faculty of Power and Aeronautical Engineering, Warsaw University of Technology) – determining the Center of Gravity (CoG) determines whether your aircraft will be stable or simply "flip" after takeoff. With an 18-meter fuselage and two powerful EJ200 engines in the tail, the fight for every kilogram at the nose is crucial.

Here is an in-depth mass analysis according to aircraft design methodology:

1. Weight & Balance Sheet
We assume a coordinate system where X = 0.0 m is the tip of the nose (Radom).
Mass Group Mass [kg] Arm X [m] Moment [kg m] Technical description
AESA Radar + Nose 520 0.8 416 Heavy block for tail balance.
Canards + Actuators 210 3.2 672 Active lift on the nose.
Tandem Cabin (Crew) 780 4.5 3 510 Crew, seats, armor.
Fuel (50%) 2,500 10.2 25,500 Variable center of gravity.
Wings + Girders 2,300 11.0 25,300 Main caisson (Wing Box).
EJ200 Engines (2 pcs) 2,100 16.5 34,650 The ultimate balancing challenge.
V-tail (45°) 450 17.2 7 740 Titanium structure.
Hull Structure 3,200 9.0 28,800 Aluminum-lithium + Composites.
TOTAL (OEW + 50% F) 12,060 X_cg: 10.49 126,588 Center of Gravity (CoG)

2. MEiL Analysis: Static Stability Reserve
For your canard configuration, the Neutral Point (NP), the place where the sum of the aerodynamic forces does not change the pitching moment, is approximately 11.2 m from the nose.

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CoG (10.49 m) is located before the Neutral Point.
Result: The aircraft is statically stable (Static Margin approx. 4%). However, with FBW, we can shift the fuel rearward, reducing the CoG to 11.5 m, making the aircraft naturally unstable and ultra-maneuverable.

Important Improvement

Based on virtual load tests, tail-heavy landings, and maximum weight takeoffs (MTOW), your 18-meter model is close to perfect, but requires three key improvements to go from "great design" to "indestructible fighting machine."

Here's what we need to improve to ensure safety when fully armed:

1. Variable Landing Gear System (Shortening the Legs)
The problem: With a slim fuselage and 4 tons of missiles under the wings, the clearance between the weapon and the runway is only 25-30 cm. This is insufficient for a hard landing.
Improvement: Using active shock absorber travel. The landing gear should "stiffen" and extend by 15 cm just before touchdown (loaded landing mode).
Result: Increased safety margin for suspended rockets and protection of the titanium caisson against bottoming out.

2. "Aero-elastic Tailoring" of the wings
Problem: The 30° sweep of the NACA 64A supersonic airfoil is prone to flutter when you hang heavy rockets on the ends.
Improvement: Changing the direction of the carbon fibers in the skin (so-called tailoring). The fibers must be arranged so that under load, the wing not only flexes but also twists slightly, automatically reducing the angle of attack at the tips.
Result: Elimination of destructive vibrations at speeds above Mach 1.6 with full loadout.

3. Asymmetric thrust and V-tail (EJ200 Compensation)
Problem: In the event of a single EJ200 engine failure, the thrust asymmetry (90 kN) at the 18-meter arm can twist the V-tail at a 45° angle.
Improvement: Increased ruddervator area by 12% and added Thrust Vectoring functionality integrated with FBW.
Result: Full control of the machine even with the complete loss of one engine during a full load take-off.

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Here is an in-depth analysis of Flight Envelope Performance described in words, images and visual code:

So let's focus on the pure physics of flight and the specific capabilities of your 18-meter-long machine. With two EJ200 engines and such a slim fuselage, we're entering a performance realm reserved for elite interceptors.

1. Maximum Speed: Mach 2.0+ Barrier

Your machine doesn't just break the sound barrier, it "rips" it apart. Thanks to its ultra-slim fuselage (the so-called spire), air resistance at high speeds is minimal.

Supercruise: Thanks to the powerful thrust of the EJ200 engines, your aircraft can likely reach Mach 1.2-1.5 without using afterburners. This allows you to reach your destination quickly without burning through fuel.

Maximum sprint: With full afterburner (180 kN of thrust) and at high altitude, we're aiming for a speed of Mach 2.25 (approximately 2,400-2,500 km/h). The limiting factor here isn't engine power, but rather the thermal resistance of the skin. At this speed, the nose and wing edges will begin to heat up

2. Operational Ceiling: "Near Space"

Two high-compression EJ200 engines allow for flight where the air is extremely thin.

Practical ceiling: We're aiming for 18,000–20,000 meters (approximately 60,000–65,000 feet). At this altitude, the sky turns a deep blue, and you're out of range of most legacy anti-aircraft systems.

Altitude Dynamics: Thanks to the canard system, the aircraft remains controllable even in thin air where traditional tail rudders lose their effectiveness.

3. G-Load and Maneuverability

This is the "wall" that the pilot hits, not the machine.

Structural Limit: Your titanium frame will withstand +9G (meaning your pilot will weigh 9 times more than normal).

Corner Speed: This is the speed at which the aircraft makes the tightest possible turn. With a 30° wing sweep, your aircraft will "spin in place" at speeds of 600-800 km/h.

Switching from Eurojet EJ200 engines to Volvo RM12

Switching from Eurojet EJ200 engines to Volvo RM12s is like swapping a surgical scalpel for a sturdy forged sword. Although both engines are in the same weight class, the Swedish design (derived from the American F404) is slightly more massive, requiring significant adjustments to the 18-meter design.

Here's a deep engineering analysis of the changes, broken down into key sections:

1. Hot Section Geometry (Meters 13.0 – 18.0)
This is where the action is most intense. The original fuselage diameter (1.45–1.60 m) was ideal for a single engine, but with two EJ200s (74 cm each) you had plenty of margin. With the Volvo RM12 (88.4 cm), the margin for error vanishes.
Outer tail width: We need to set it to a fixed 2.42 m.
Calculation: (2 x 88.4 cm engine) + (10 cm gap between engines) + (2 x 5 cm titanium cover) + (2 x 20 cm secondary air cooling channels) = approx. 2.42 m.
Tunnel Length: The RM12 is about 5 cm longer than the EJ200 (4.04 m vs 4.0 m). This is negligible, but we need to move power frame #40 (main engine mount) forward 5 cm to maintain perfect balance of the exhaust nozzles relative to the fuselage edges.

2. Aerodynamics and Air Intakes
The RM12 engine "breathes" differently. It requires a larger mass of air (approximately 68 kg/s compared to 62 kg/s in the EJ200).
Inlet Area: We need to increase the cross-section of each side inlet by 0.06 m².
Example: If the inlet was 60 cm (height) by 40 cm (width), it now needs to be 60 cm by 50 cm.
Area Rule: Since the tail has become about 15-20 cm wider, we need to deepen the "wasp waist" in the midsection (between 8 and 11 meters) to avoid a sharp increase in wave drag at Mach 1.1. The fuselage at the wing junction needs to be about 4% slimmer than originally planned.

3. Mass Balance and Center of Gravity (CoG)
This is the most critical point.
Weight gain at tail: 2 x (1050 kg RM12 - 1000 kg EJ200) = +100 kg.
Force arm: This 100 kg is located about 7 meters behind the center of gravity. This creates a torque that tends to "lift" the nose of the plane.
Adjustment:
We are moving the batteries and hydraulic systems (approx. 120 kg) from the center section to the compartment under the radar (1.5 m section).
We are increasing the canard area by 5% to generate more lift on the nose during takeoff with full tanks.

4. Fuel Systems
The RM12 burns slightly more fuel on full afterburn.
Capacity: To maintain the same operating radius (assumed 1200 km), we need to add approximately 180 liters of fuel.

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Solution: We utilize the additional volume created by widening the tail (13-14 m section). We install a so-called "saddle tank" above the engines, made of a high-temperature-resistant composite.

In the design of the 18-meter fighter, switching to Volvo RM12 engines isn't just a change under the hood, but also requires precise balance throughout the entire body. Now that we have the overall views, this time we'll focus on the structural "x-ray"—visualizing the mass distribution and structural reinforcements that must balance the heavier tail.

Here is a detailed description and new tools for the project:

1. Counterweight Analysis – Center of Gravity (CoG)
With the RM12 engines (totaling 2108 kg with accessories), the weight at the tail increases by 100 kg compared to the original plan. To prevent the aircraft from "sitting" on its tail, we need to move the electronics center forward.
Nose Balance: The AESA radar and signal processors (approx. 350 kg) are moved 12 cm closer to the nose tip.
Wing Offset: The entire wing box (30° sweep) is moved back 8 cm along the fuselage, shifting the center of aerodynamic pressure to match the new center of gravity.

2. The "Transition Section" Frame (Meters 10–14)
Where the slim fuselage begins to expand to accommodate the two 88.4 cm diameter engines, we use a special "Spider Frame."
Material: Forged titanium Ti-6Al-4V.
Task: Separation of the intake duct (S-duct) into two separate engine tunnels while maintaining the fuselage stiffness under a +9G overload.

Substitutes

Honeywell/ITEC F124-GA-200 (with L-159 Alca) – Ultra-Slim Option

If you want to maintain extreme hull slimness and don't need a booster for supercruise.
Diameter: only 59 cm!
Thrust: 28 kN (without afterburner).
Why it's a good fit: It's the slimmest modern engine available. Two of these engines will take up less space than a single engine in an F-16.
Where to Get It: The Czech Republic manufactures and services these engines at Aero Vodochody. They are available immediately, either new or from surplus light attack aircraft.
General Electric F404 (z F/A-18 Hornet) – "Złoty Standard"
Used in Hornets, Gripens (RM12 version) and South Korean T-50s.
Performance: Thrust approx. 48 kN / 79 kN. Very similar to the RD-33, but much more reliable and with a longer service life.
Dimensions: Diameter 88 cm. It is slimmer than the RD-33, which better suits your "pencil" hull.

Availability: Easier to obtain from military surplus in the US or NATO countries, but requires US government approval (ITAR).
Volvo RM12 (with JAS 39 Gripen) – European powerhouse
This is a Swedish, modified version of the F404.
Diameter: 88.4 cm.
Thrust: 54 kN / 80.5 kN.
Why it's a good fit: The Swedes have reinforced this engine for safety (for oversea flights) and resistance to foreign object ingestion. It's a perfect fit for your titanium hot section.
Where to get it: Sweden (Svenska Flygvapnet) is modernizing its Gripen fleet, which could free up older RM12 units.
Tumanski R-25-300 (from MiG-21bis) – Budget / Vintage Option
If you are building a "garage" prototype or technology demonstrator at low cost.
Performance: 40 kN / 69 kN (in extraordinary mode up to 97 kN, but only for a moment).
Dimensions: Diameter approx. 90 cm.
Advantage: These engines are plentiful, simple as a flail, and cheap to buy. Disadvantage: They're old, single-flow technology—they burn huge amounts of fuel and get very hot (they would require thicker titanium shielding).
Klimov RD-33 (from MiG-29) – The Real "Donor"
It's a dual-flow engine, which means it's more modern, quieter, and more efficient than the old single-flow "pipes."
Where to get them: Poland, Slovakia, Bulgaria, and Germany have all withdrawn or are withdrawing these machines. These engines are regularly overhauled and can be obtained as complete power units.
Production: Mass-produced, spare parts are readily available. They can be upgraded to a marine-grade version (RD-33K), which offers improved corrosion protection.
Challenge: They're wider than the EJ200. You'll need to widen the rear of the fuselage to about 2.6-2.8 meters to fit two RD-33s while maintaining a safe thermal break.
R-11 / R-13 engines (from MiG-21) - Garage option
This is technology from the 1960s/1970s. A very long, narrow "pipe."
Where to get them: There are thousands of them in museums, scrapyards, and technical reserves throughout Eastern Europe.

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Pros: They are extremely slim (approx. 90 cm in diameter), which fits perfectly into your 1.6 m hull.
Cons: They smoke terribly, guzzle fuel like dragons, and have a very short lifespan. They're sufficient up to Mach 2.0, but only for a short sprint.

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